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Marine biological productivity, carbon cycling, and climate cooling during the Oligocene to Miocene transition

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The Oligocene to Miocene boundary (the so-called Mi1 event) marks one of the major Cenozoic cooling steps. A corresponding but slightly out of phase [U+F064]13C maximum has been attributed to increased organic matter burial associated with global climate cooling (e.g., Zachos et al., 2001). To test this idea we have constructed records of marine biological productivity (based on benthic foraminiferal accumulation rates, BFAR) to parallel the stable isotope records from 20-25 Ma at three sites from the Atlantic Ocean sampling different hydrographic regimes. Our data show that the [U+F064]18O and [U+F064]13C maximum that characterize the Oligocene/Miocene boundary is accompanied by a pronounced maximum in BFAR derived paleoproductivity at all sites. In the subtropical Atlantic (Site 1265) and the Southern Ocean (Site 1090), productivity increases about 500 kyr prior to Mi1 in tune with the beginning of enhanced amplitude variations in the benthic foraminiferal [U+F064]13C record. In the tropical Atlantic (Site 926), where we have appropriate sampling resolution ($\sim$10 kyr), eccentricity-scale variations in paleoproductivity are coherent with the stable isotope records and in-phase with the [U+F064]18O values. Paleoproductivity leads [U+F064]13C at the 400 kyr period in agreement with the lead of [U+F064]18O values with respect to [U+F064]13C values. These results illustrate that the link between Oligocene to Miocene climate transition and the carbon cycle is one of marine primary productivity both during the glacial event of Mi1 as well as on eccentricity time scales. The late Oligocene (24 Ma) increase of productivity suggests that a reduction of atmospheric CO2 levels mediated by increased biological productivity may have lead to climate cooling at the Oligocene to Miocene boundary.